GreenSTEP: Greenhouse Gas Statewide Transportation Emissions Planning Model

Innovations in Travel Modeling 2010
Transportation Research Board Conference
Plenary Session S2: The Raison d’etre of Travel Modeling
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Brian Gregor
Oregon Department of Transportation
Changes in the Raison d’etre of Travel Modeling
**Travel Modeling Past**

Reasons for Modeling
- Planning road expansions
- Planning transit expansions
- Analyzing land use changes
- Air quality

Social and Environmental Context
- Increasing “automobility”
  - Increasing auto ownership
  - Focus on expansion of road system
- Expansion of labor force, household incomes, consumption
- Increasing congestion
Travel Modeling Future

Social and Environmental Context
- Greenhouse gas (GHG) emissions and climate change
- Resource depletion, scarcity, environmental impacts
- Saturation of automobility (in the U.S.)
- Declining birth rates, increasing median age

Reasons for Modeling
- Managing vehicle travel and emissions from vehicle travel
- Integrating land use and transportation decisions
- Planning for low carbon transportation vehicles & modes
- Planning for affordable accessibility
Travel Modeling Approaches Need to Change

The fundamental changes in the priorities and challenges of planning caused by climate change and energy scarcity will have significant impacts on the philosophy and method of urban modelling:

- non-marginal rather than marginal changes
- less reliance on observed behavior
- more attention to strong theory
- less choice but more constraints
- less statistical calibration, more plausibility analysis
- less detail but more comprehensiveness
- fast models to allow many exploratory scenarios
- etc.

Michael Wegener
The GreenSTEP Model
Background

- **GreenSTEP = Greenhouse gas State Transportation Emissions Planning model**

- Work started (2008) at the request of the Oregon Global Warming Commission (OGWC) for a model to evaluate a broad range of GHG policies

- GreenSTEP is a strategic planning model:
  - Broad (comprehensive) scope
  - Behavioral but with less detail
  - Logical (theoretical) components to address behavior where data is limited
  - Fast enough to allow more complete exploration of the problem space
GreenSTEP Policy Sensitivity

- Demographic and income changes
- Relative amounts of development occurring in urban and rural areas
- Metropolitan and other urban area densities
- Urban form
- Amounts of metropolitan area public transit service
- Highway capacity
- Vehicle proportions: autos, light trucks, EVs, plug-in HEVs, lightweight EVs
- Vehicle ages
- Vehicle fuel efficiency
- Pricing of fuel, carbon, VMT, parking
- TDM and eco-driving
- Effects of congestion on fuel economy
- Lifecycle carbon content of fuels
- CO2 production from electrical power use for transportation
Generate Synthetic Households

Apply urban area land use and transportation system characteristics

Model vehicle ownership types and ages

Model initial estimates of household vehicle travel

Model household vehicle types and allocate VMT to vehicles

Calculate household costs per vehicle mile

Recalculate household vehicle travel and adjust allocation to vehicles

Aggregate characteristics by county, income group and development type

Model heavy vehicle VMT

Adjust MPG due to congestion

Calculate fuel consumption by type

Calculate lifecycle CO2e emissions by fuel type
GreenSTEP Approaches to GHG Strategic Modeling Challenges
How do you represent “detailed” (tract level) land use attributes in a statewide strategic model?
How do you address day-to-day travel variability which is important to the assessment of GHG policies but not captured by many travel surveys?
How do you model emerging or anticipated trends for which there is insufficient data to develop a statistical model?

Average Household DVMT Reduction by Car Shedding Rate
3 Person Household Size Limit

Miles Reduction in Household DVMT

-7.08 (Cervero 2007)
-7.71

21%

Percent of Carsharing Households Giving Up a Vehicle
How do you model something new?
How do you make behavioral models sensitive to macro level trends?

Estimated and Observed Light Truck Ownership
By Income Group and Density (100 runs)
Example GreenSTEP Version 1 Outputs
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**Annual CO2 Equivalent Emissions**

**Density Scenarios**
Annual CO2 Equivalent Emissions
All Vehicle Efficiency & Fuels Scenarios

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<th>Year</th>
<th>Med Lt Veh Eff</th>
<th>High Lt Veh Eff</th>
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Next Steps

• Complete version 2 of the light vehicle model
• Complete long-distance travel model
• Develop multimodal freight model
• Apply GreenSTEP in development of statewide transportation strategy for reducing GHG emissions

Contact:
Brian Gregor, Oregon Dept. of Transportation
Brian.J.Gregor@odot.state.or.us